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motion in longitude applies, are, therefore, 2136, 2383, and 2411 years respectively. The alterations of Moon's motion in longitude (adopting the formula of the last paragraphs) are 12′ 49″, 14′ 18″, 14′ 28″. The tabular places of the Moon will be increased by these quantities.

In my paper 'On the Eclipse of Agathocles, the Eclipse at Larissa, and the Eclipse of Thales,' published in the Society's *Memoirs*, vol. xxvi., page 147, I have remarked that the diminution of Secular Acceleration, from the value employed by Professor Hansen to that proposed by Professor Adams, and supported by the investigations of Delaunay and others, would diminish the tabular longitude of the Moon by 160″ for 1000 years. The effect for the intervals of years above given (proportional to the square of the time) would be 12′ 10″, 15′ 8″, and 15′ 30″. This effect, therefore, so nearly balances the other, that the general result may be thus stated. The eclipses, as described in the paper to which I have referred, are accounted for almost equally well, either by Hansen's Tables, including the equation now rejected, and including also Hansen's secular acceleration; or by Hansen's Tables, deprived of that equation, and combined with a secular acceleration diminished to the extent which I have indicated.

My confidence, however, in the certainty of chronological results, derived from lunar calculations, is in some measure shaken by the character of the unexplained inequality in the epochs of Moon's mean longitude, to which I have called attention.

Royal Observatory, Greenwich,
1873, *October* 8.

On the Correction to Hansen's Semi-Diameter of the Moon from Occultations of Stars. By E. Neison, Esq.

In the Appendix to the volume of *Greenwich Observations* for 1864, Sir George Airy has shown, from the computations of Mr. Breen, that the value for the Moon's semi-diameter given by occultations of stars by the Moon, is less than the apparent telescopic semi-diameter by more than two seconds of arc. As the value for the mean telescopic semi-diameter was derived from the Greenwich observations, and was regarded as an accurate determination of the Moon's semi-diameter as viewed with the Greenwich instruments, this difference was looked upon with considerable interest.

Hansen's value for the semi-diameter of the Moon being regarded as expressing very accurately the true semi-diameter of the Moon, it became a matter of interest to determine whether any similar difference occurred with regard to this value and that given by occultations of stars by the Moon. It was, moreover, desirable to extend the period embraced by Mr.

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Breen's computation from the end of 1860 up to 1870, the latest period available; thus increasing the number of phenomena in each class, which was rather small for the purpose of an investigation of this kind.

The method adopted was the same as that described by the Astronomer Royal in the Introduction to Mr. Breen's Results (*Greenwich Observations*, 1864, Appendix 1), and therefore does not require to be detailed here.

The corrections to the tabular R.A. and N.P.D. of the stars were obtained from the following sources. For the years 1861 to 1868, from the Annual Catalogue in the *Greenwich Observations* for each year, and from the Greenwich Seven Year Catalogues for the epochs of 1860 and 1864; the mean being taken by giving a proportional weight in each case according to the number of observations. For the years 1868 to 1870 the places were taken from the *Greenwich Observations* for those years, and from the New Seven Year Catalogue, the mean value likewise being taken, with due allowance for the number of observations. The places of two stars had to be derived solely from the Greenwich Twelve Year Catalogue, and those of two others in the first division depend on observations made during 1868 and 1869, contained in the *Greenwich Observations* for those years.

The corrections to the tabular places of the Moon are derived in every case from the observations made during the same day at Greenwich, and are obtained by changing the sign of the tabular errors of the Moon's place given in the *Greenwich Observations*. With ten exceptions the mean of the errors in the Moon's place, according to the transit-circle and altazimuth was taken; and in these exceptional cases the value given by the altazimuth has been adopted, as no observations with the transit-circle had been made.

On substituting these values of e, f, x, and y in the well-known final equation given in the *Greenwich Observations*:—

$$\text{Tabular semi-diameter} - \text{computed semi-diameter} = \text{A} \times e + \text{B} \times f + \text{C} \times x + \text{D} \times y;$$

A B C D being the coefficients multiplying the corrections to the places of the Moon and star, and adding the sum of the products to the quantity on the left side of the equation with its sign changed, we have at once the correction to the tabular semi-diameter.

As during the years 1862 to 1870 the values used in the Greenwich reductions of occultations are Hansen's, this gives, without anything further, the correction to Hansen's semi-diameter. For the year 1861, however, the values for the Moon's semi-diameter and parallax differ from Hansen's, and it becomes necessary to apply a further correction. The Greenwich semi-diameter used exceeds Hansen's by $1''\cdot21$, which must therefore be subtracted from the correction given by the above equation.

Hansen's value for the parallax is less than the value employed

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for the tabular places of the Moon in the Greenwich reductions of occultations for 1861, by 2″·7: giving a value to the function denoted *m* in the Greenwich notation of −0·7894; which, multiplied by its proper coefficient, must be applied to the correction obtained as described above.

The resulting corrections to Hansen's semi-diameter were finally classified under four heads; but it was found necessary to omit three or four in which the correction was greater than eight seconds, the reason for which, with one exception, being found in the remarks attached to the observations.

The mean of the results is as follows:—

I. Disappearance of stars at the Dark Limb.

Mean correction to Hansen's semi-diameter from 35 observations −1″·70.

II. Disappearance of stars at the Bright Limb.

Mean correction to Hansen's semi-diameter from 11 observations +1″·81.

III. Reappearance of stars at the Dark Limb.

Mean correction to Hansen's semi-diameter from 20 observations −0″·36.

IV. Reappearance of stars at the Bright Limb.

Mean correction to Hansen's semi-diameter from 10 observations +1″·31.

The observations of the phenomena in Classes II. and IV. are of so very delicate a nature, and are comparatively few in number, that less reliance can be placed on them than on the other two: or to use the words of Sir George Airy in his Introduction to the Results of Mr. Hugh Breen's Computations:—"Of these means, the first and third are (from the nature of the observation) very far superior to the second and fourth, and the first is greatly preferable to the third. The second and fourth classes, as might be expected, give an occultation semi-diameter larger than the first and third class."

As a result, we have a correction to the value of Hansen's for the Moon's semi-diameter exceeding one-and-a-half seconds of arc, derived from the most reliable class of occultations, namely, disappearances at the Dark Limb; and there would appear difficulties in explaining this by the effects of irradiation. For in the discussion of the eclipse of the Sun of December 21, 1870, the observations with the great equatorial indicate that the effect of irradiation, when exerting its maximum effect in reducing the semi-diameter, only diminishes Hansen's value for the semi-diameter by half a second of arc. The true value for the Moon's semi-diameter it would appear, therefore, cannot be less than this would indicate, while the occultation semi-diameter is considerably less.